



Seasonal climate prediction With GEOS-5

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The GMAO's Mission

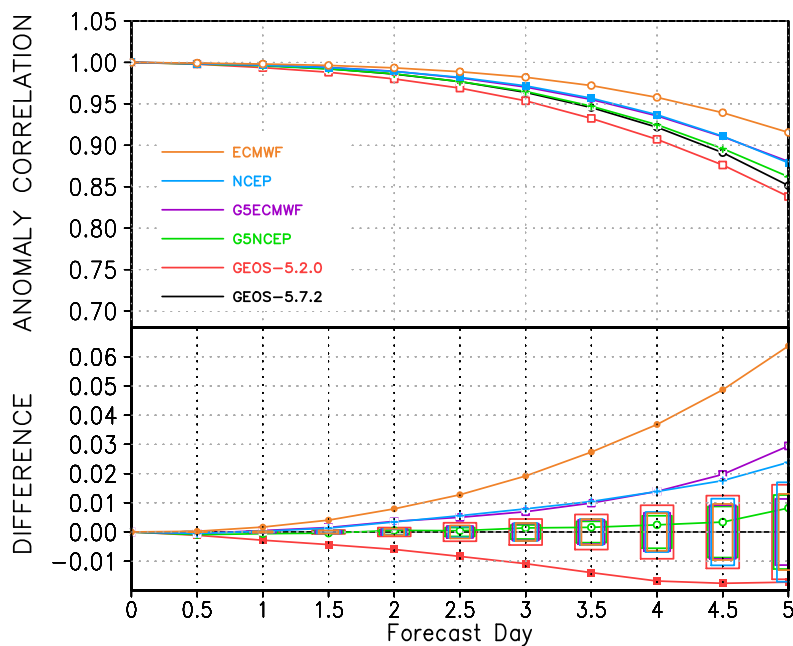
To develop and maintain global assimilation and modeling systems to support NASA's Earth Science Mission. This includes supporting instrument teams and field campaigns, generating comprehensive climate-relevant data sets to support studies of variability and change, as well as addressing the weather and climate research questions identified in NASA's mission.

Our long-term goal is the development of an Integrated Earth System Analysis (IESA) capability.

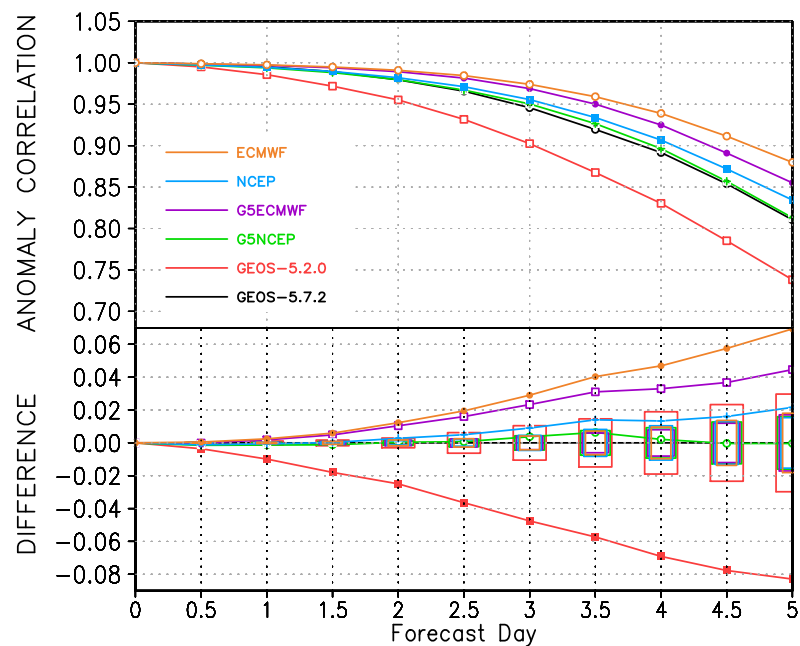


GEOS-5 in NWP – April 2011

NHE 500 hPa



SHE 500 hPa





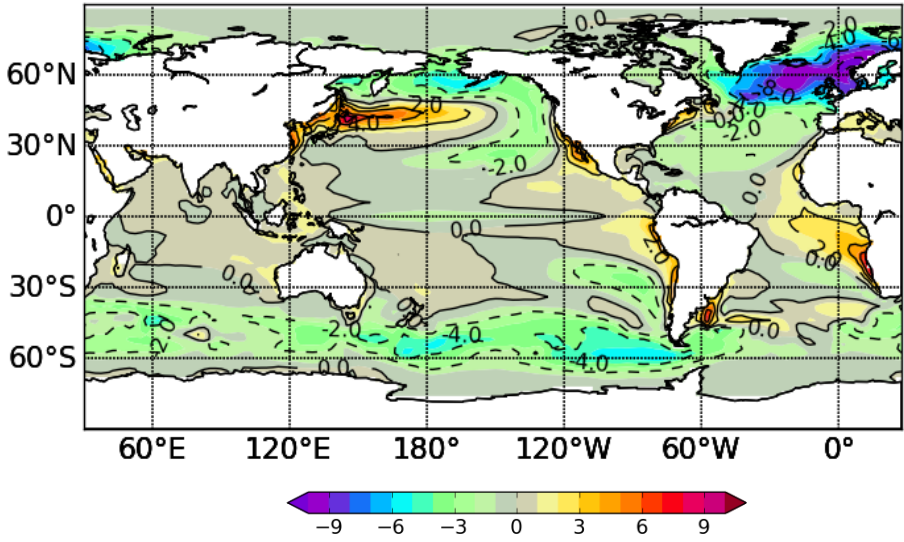
The GMAO AOGCM for S-I and decadal

GEOS-5(6) AGCM	<p>1° lat. X 1.25° lon. X 72L (0.5x91L) surface to 0.01hPa (~80 km) Finite Volume Lat-Lon Dynamical Core (cubed, non-hydro) RAS convection scheme with stochastic Tokioka Bacmeister et al. prognostic clouds (M-G-B Microphysics) Chou-Suarez radiation (RRTMG option) Louis-Lock PBL schemes (??) Catchment Land Surface Model (v1) (v2+Thornton)</p>
OGCM: MOM4	<p>MOM4p1 1/2° lat. x 1/2° lon. with 1/4° equatorial refinement 40 vertical levels Tripolar grid z coord; conservative temp., KPP+tidal mixing</p>
CICE v4.1	<p>Sea-ice thermodynamics (Exchange) Sea-ice dynamics and advection(Tripolar)</p>
Coupling Scheme	<p>Exchange grid based Diurnal interface layer 30 minute interval</p>
ANALYSIS	<p>Atmosphere: GSI Ocean: EnOI</p>

Annual Mean Model Bias

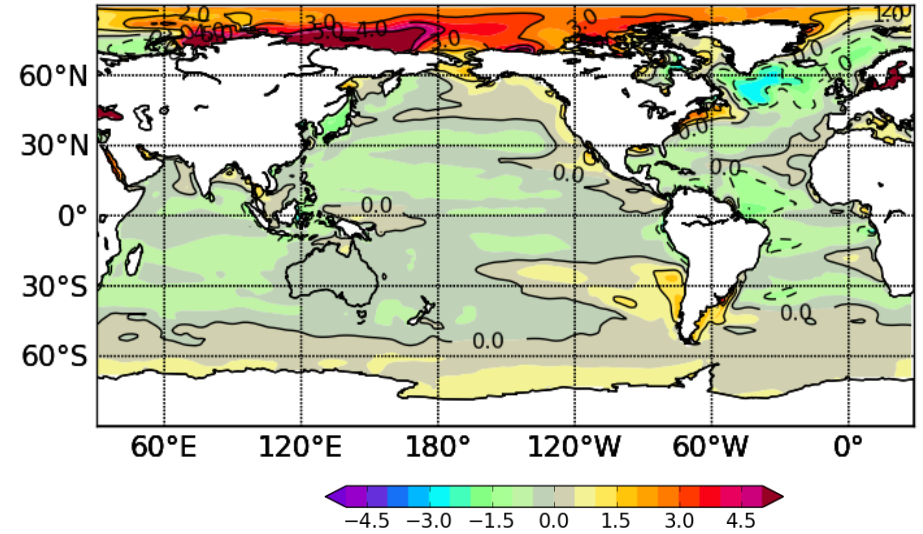
mean: -0.54
std: 2.00

GEOS-5 – Reynolds SST



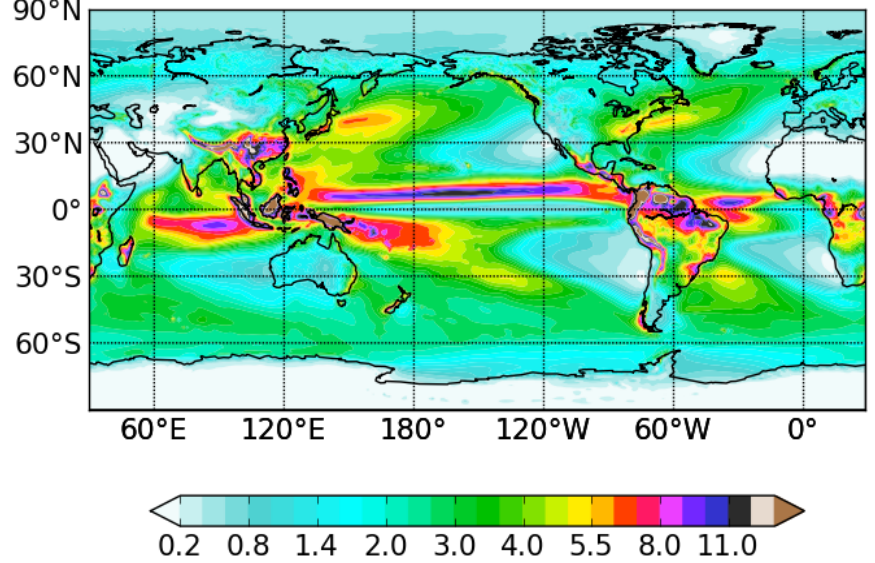
mean: -0.07
std: 1.30

GEOS-5 – Levitus SSS



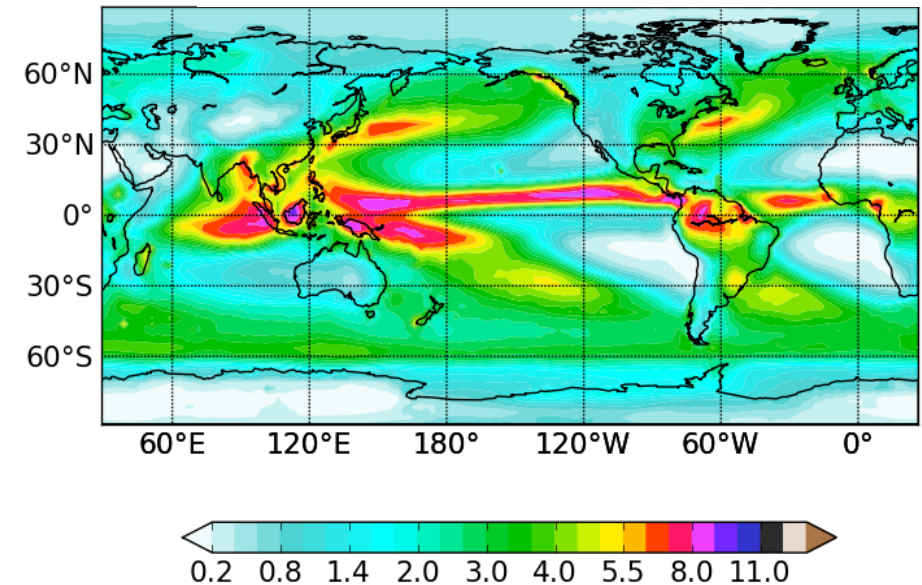
mean: 2.98
std: 2.62

GEOS-5 – Annual Mean Precip



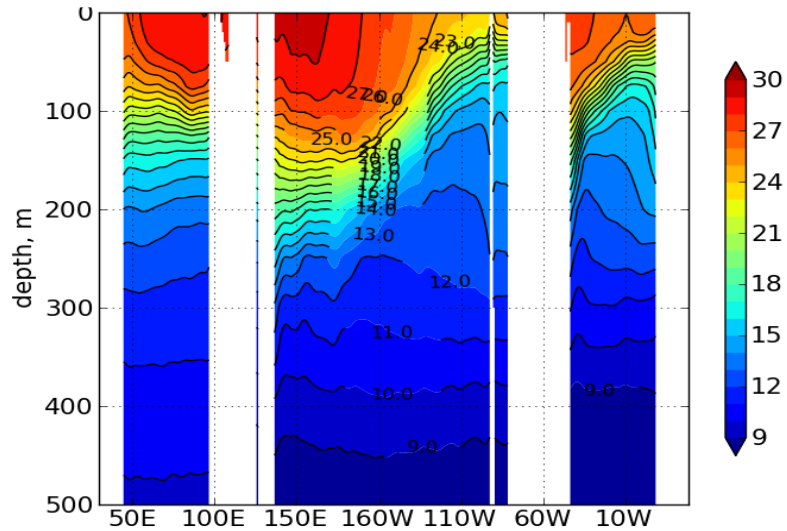
mean: 2.62
std: 1.82

GPCP – Annual Mean Precip

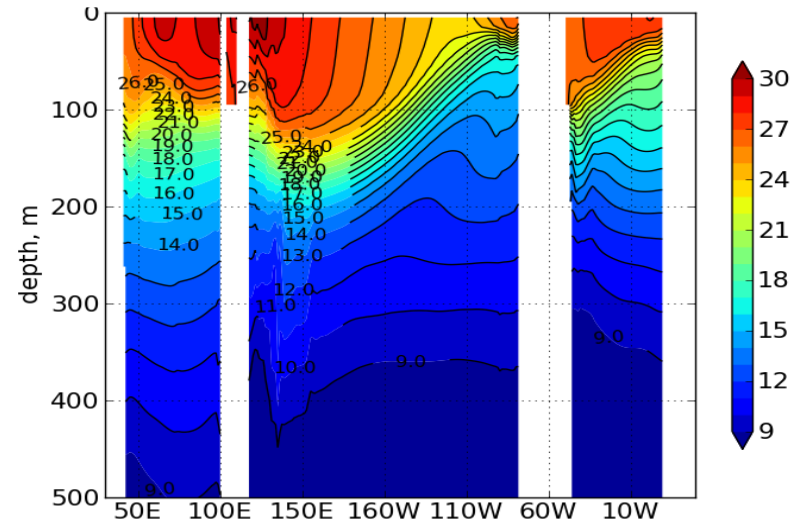


Annual Mean Equatorial Temperature

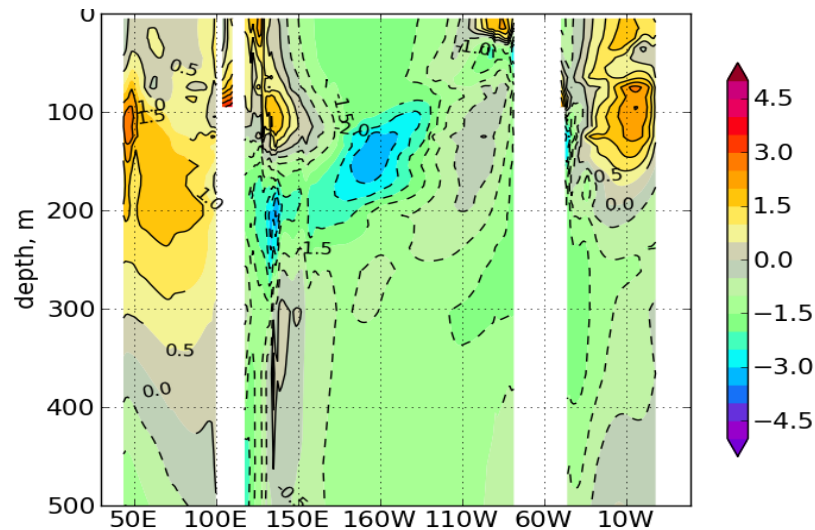
Levitus



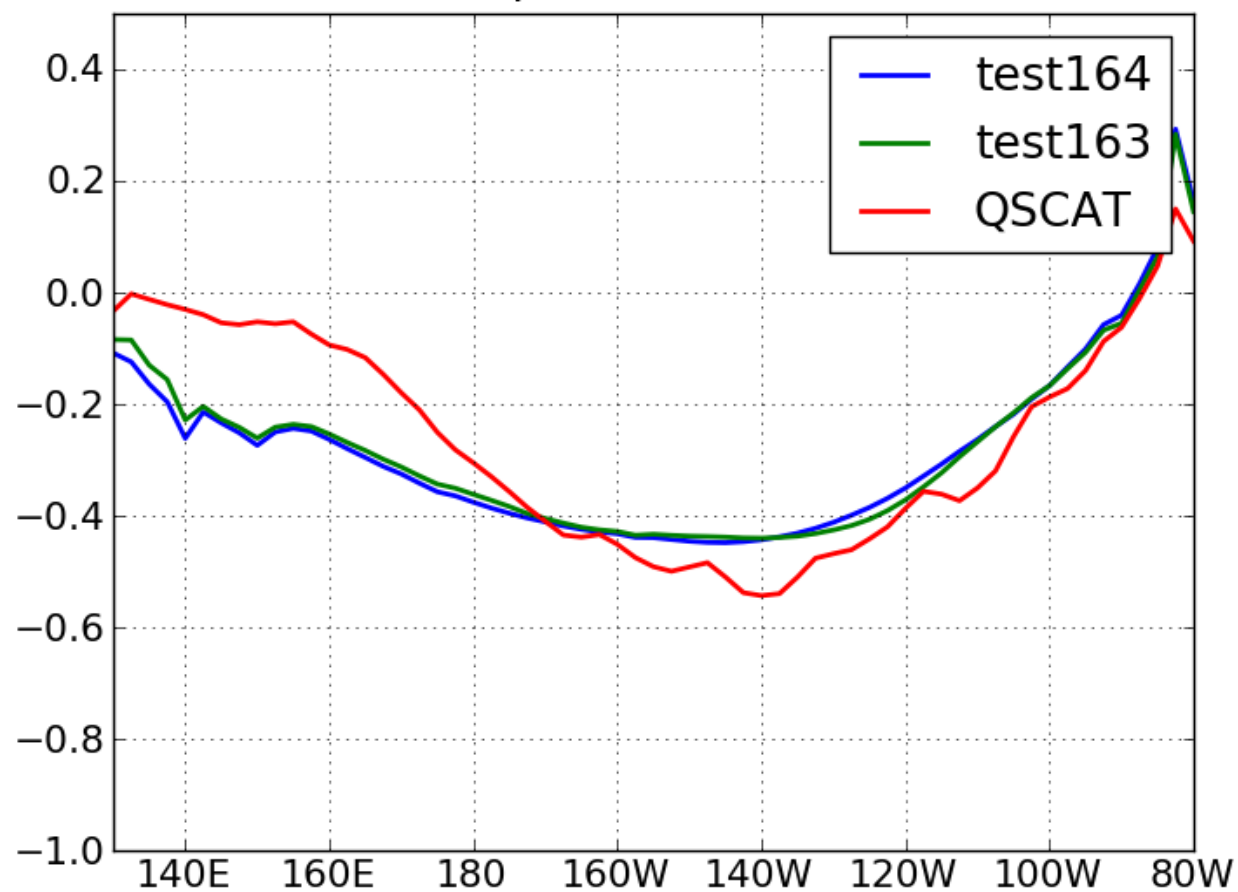
GEOS-5



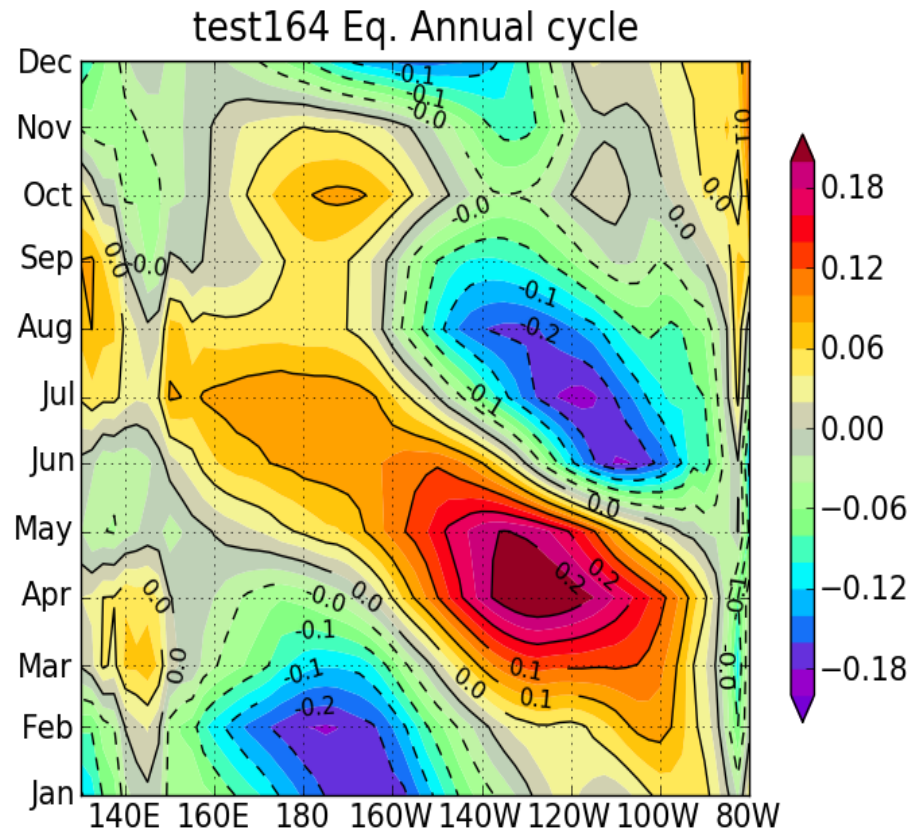
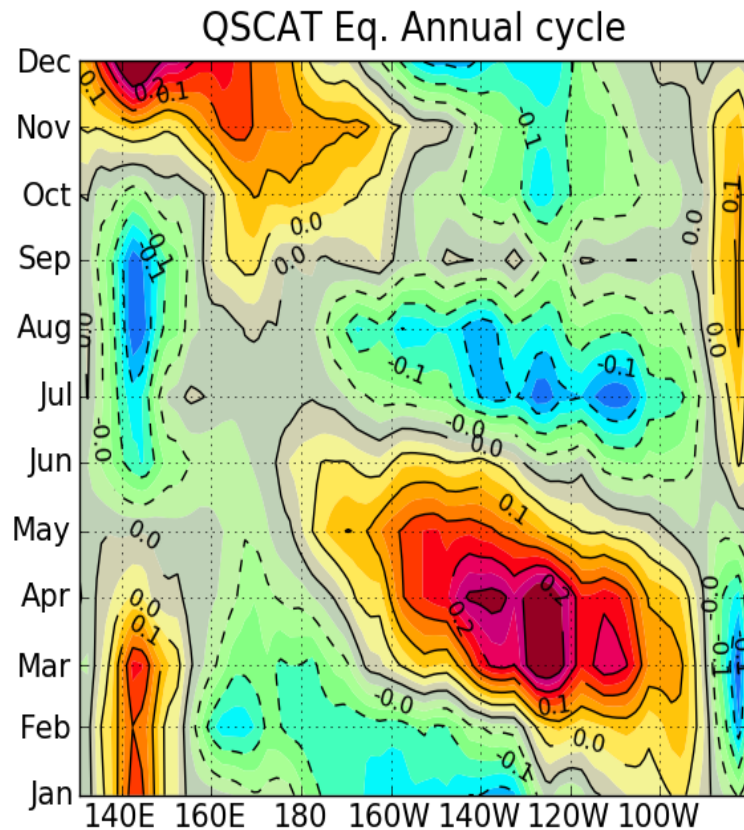
Δ



Equatorial TAUX

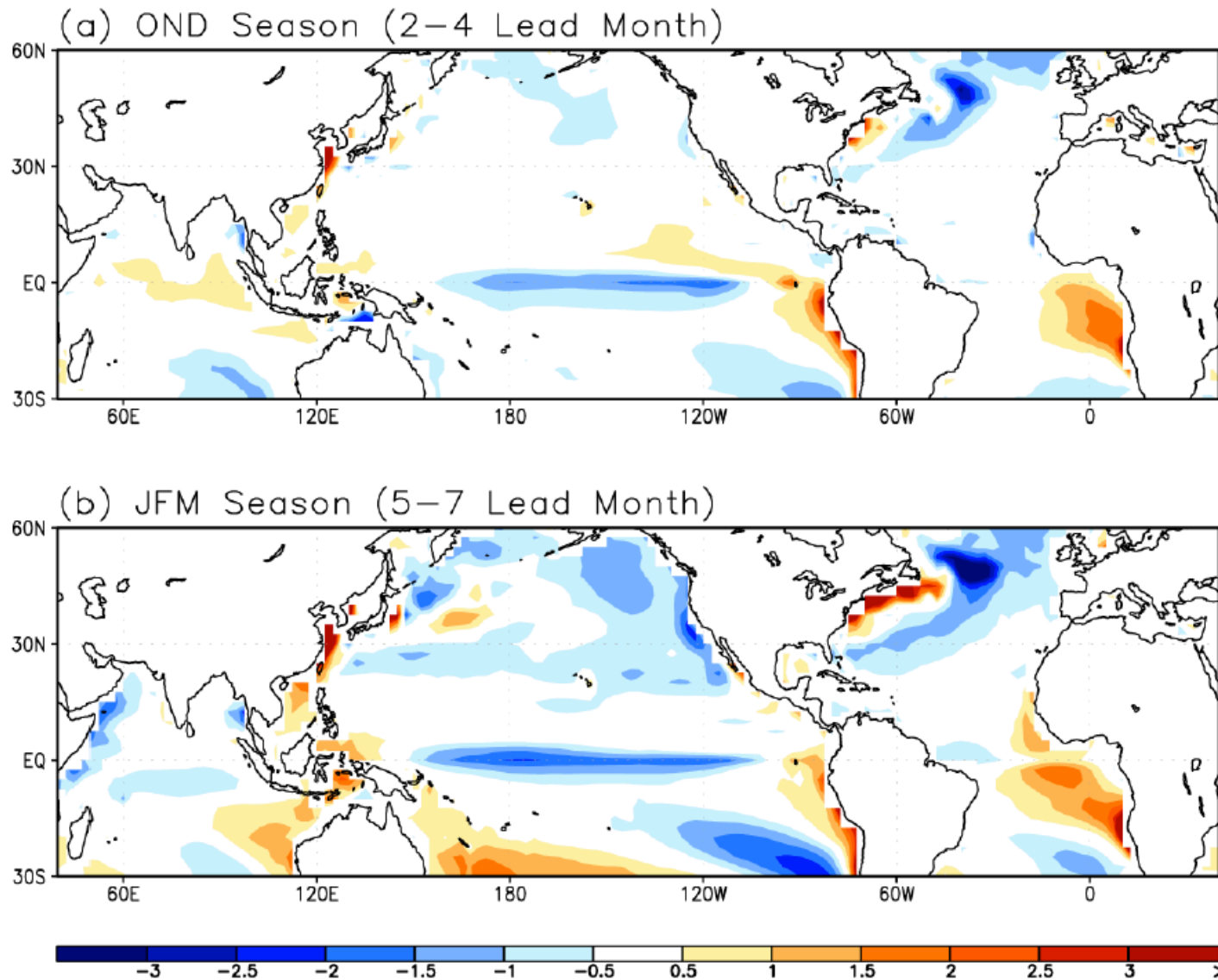


Equatorial Wind Stress, $\times 10 \text{ N/m}^2$



SST Forecast Bias 1981-2009

Based on 3 ensemble members close to 1 Sept (Aug 24, Aug 29, Sept 3)





Coupled A-L-O-S initialization of seasonal predictions

Atmosphere constrained by MERRA every 6 hours

- Precipitation rescaled to GPCP for LSM

Ocean: daily assimilation

- Ensemble Optimal Interpolation (EnOI)
- State dependent localization based on density
- 1960 to present

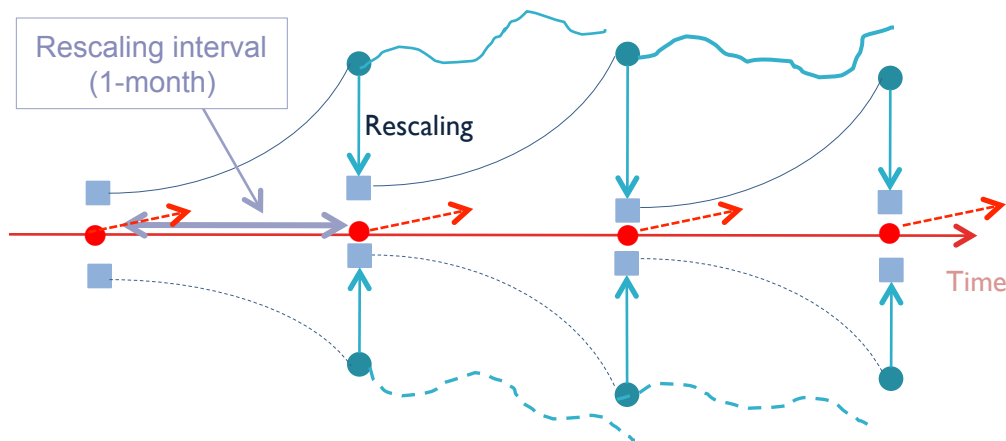
Sea-ice: daily assimilation of sea-ice concentration



1950's	1960's	1970's	1978	1979	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	2010
Levitus T and S (5% of global profiles, randomly chosen)																				
CMIP AICE					NSIDC AICE															
CTD T and S																				
XBT T and S (Temperature profiles corrected à la Levitus; synthetic salinity profiles)																				
CMIP SST						Reynolds SST														
					TAO T and S (Synthetic salinity profiles)															
											SLA from Topex, Jason-1 and Jason-2									
													Argo T & S							
															PIRATA T and S					
																	RAMA T and S			

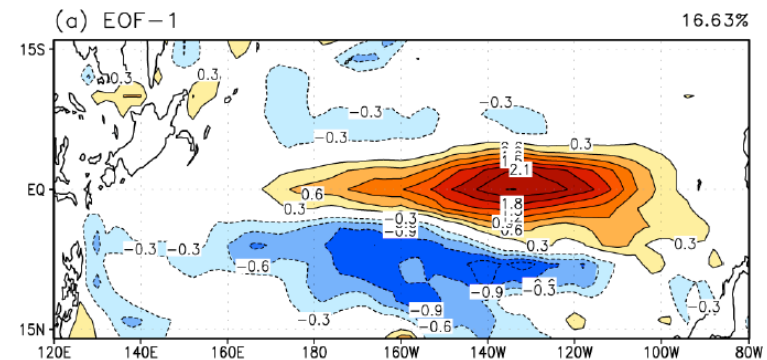
Next: Generation of Ensemble Perturbations

- Method : **Two-sided breeding**
- Norm variable : **SST**
- Norm Region : **Equatorial Pacific (5S-5N)**
- Initial BV magnitude : **Reduced to 10% of natural variability**
- Rescaling Interval : **2-month**



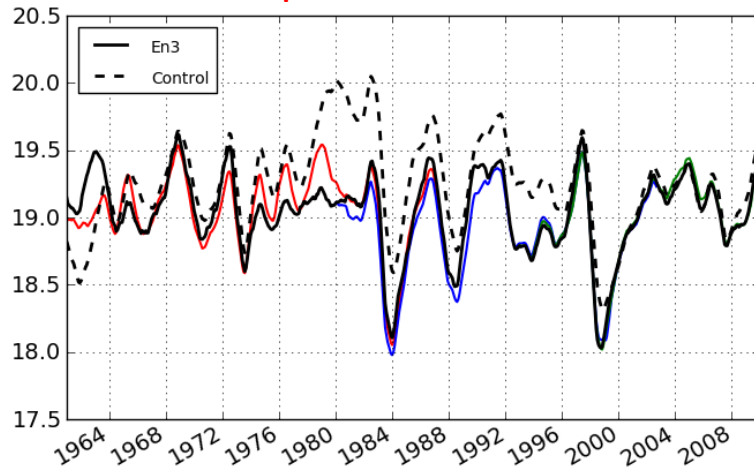
- IC: A-L-O-S Reanalyses
- Bred Vectors
- Perturbation from BV

1st EOF of HC300 from BVs

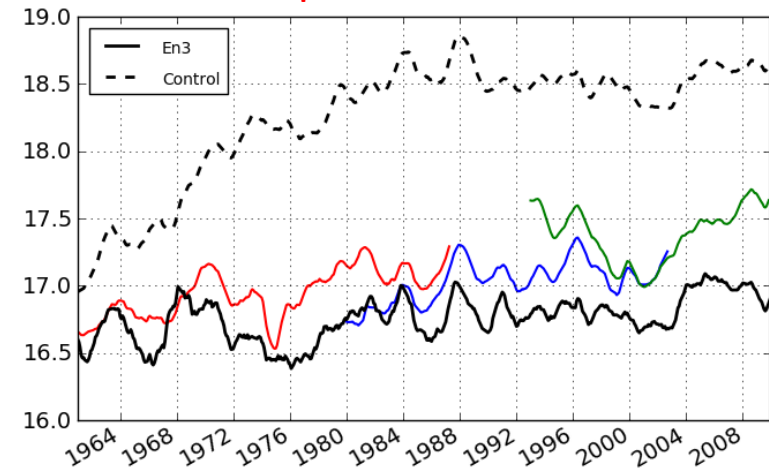


Tav 300m Basin averages, 5S-5N

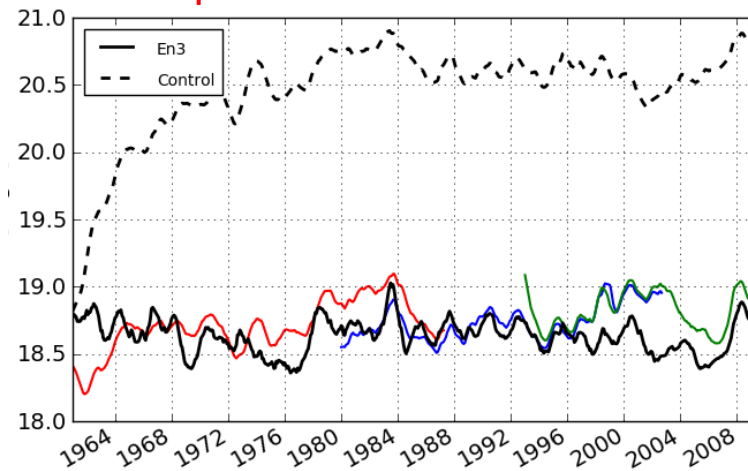
Equatorial Pacific



Equatorial Atlantic

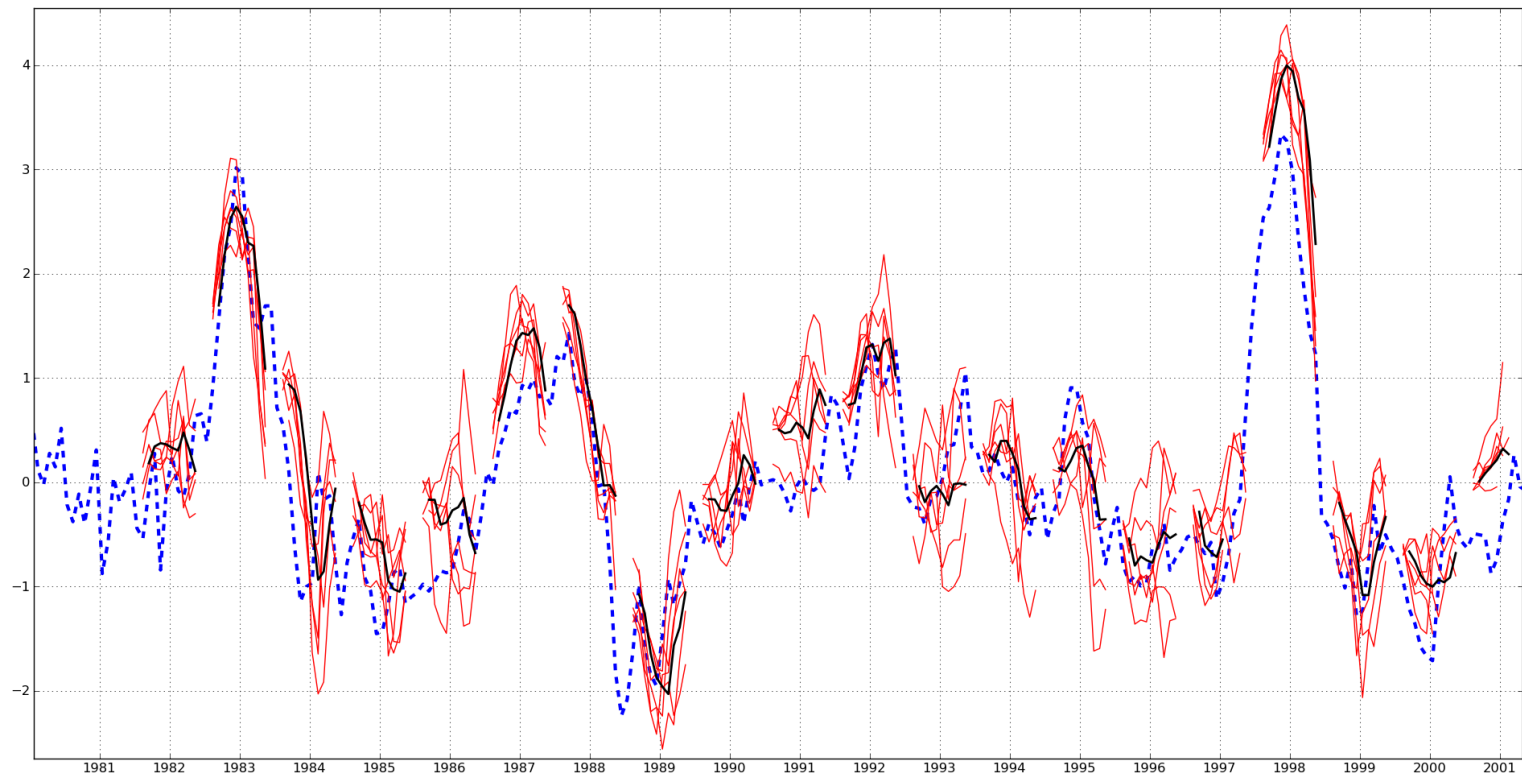


Equatorial Indian Ocean



EN3 data and analyses courtesy of
Simon Good, UKMO

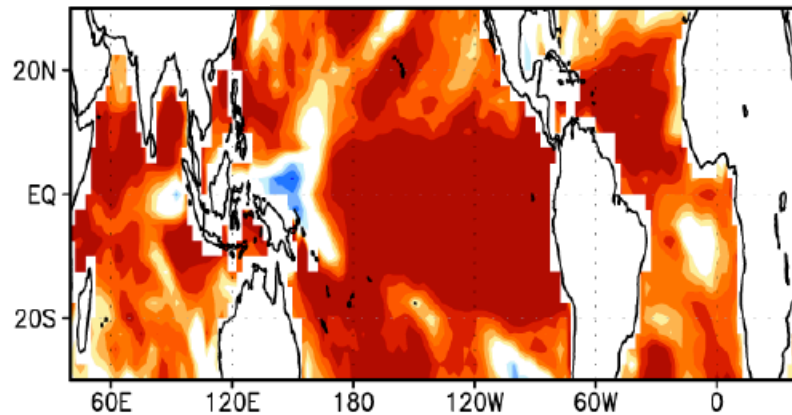
Nino3 SST Anomaly – Forecast (from August i.c.) c.f. Observed



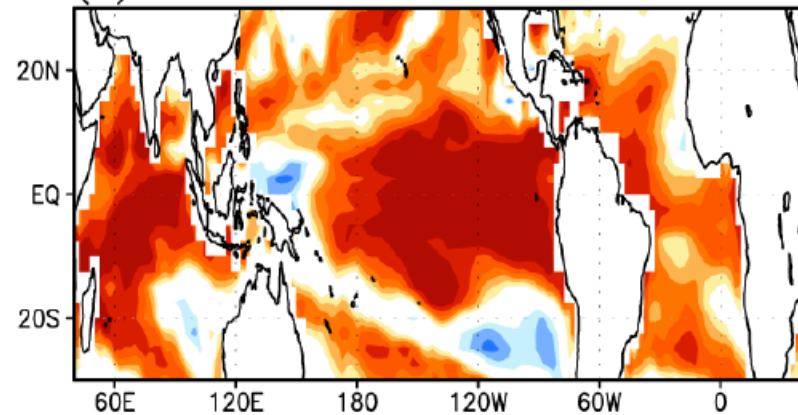
SST Anomaly Correlation 1993-2009

Based on 3 ensemble members close to 1 Sept (Aug 24, Aug 29, Sept 3)

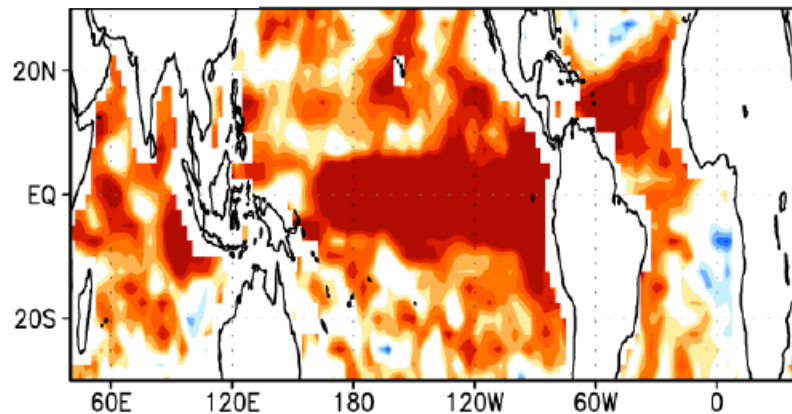
GEOS-5 OND Season



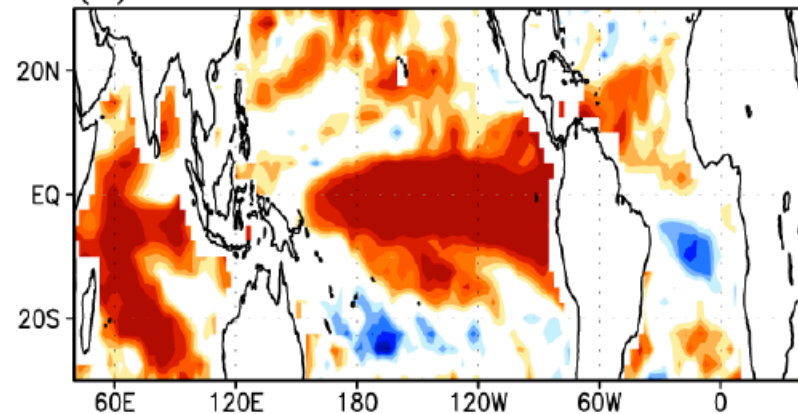
(b) New : JFM Season



CGCMv1 OND Season

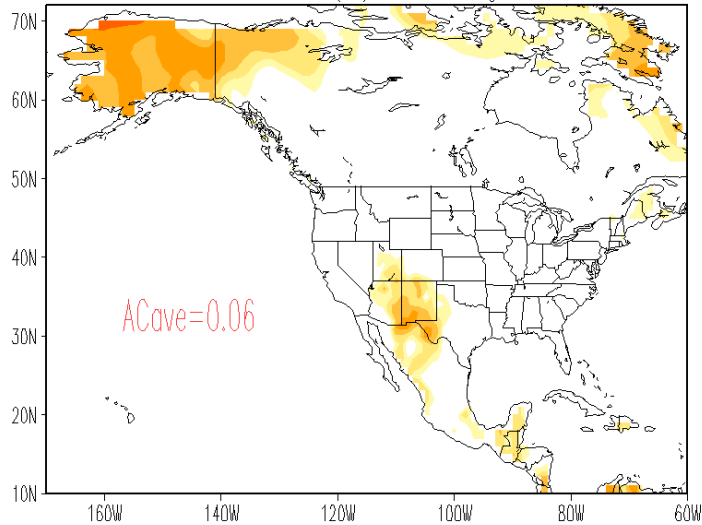


(d) Old : JFM Season

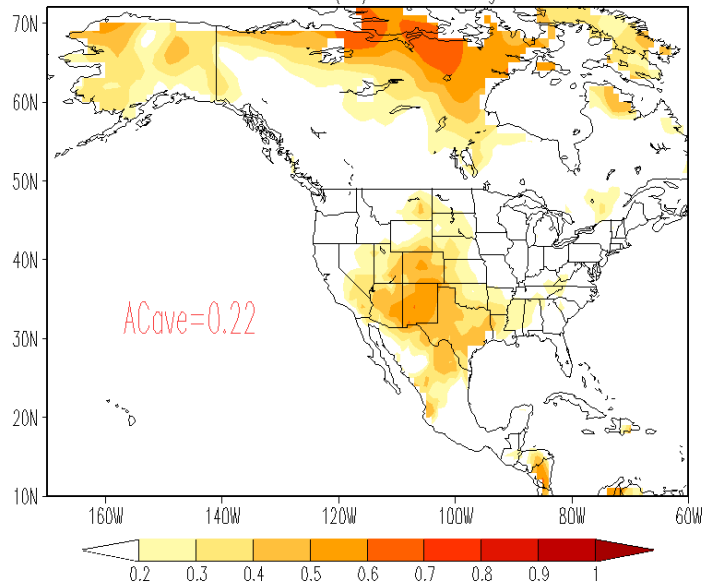


T2m Forecast Anomaly Correlation

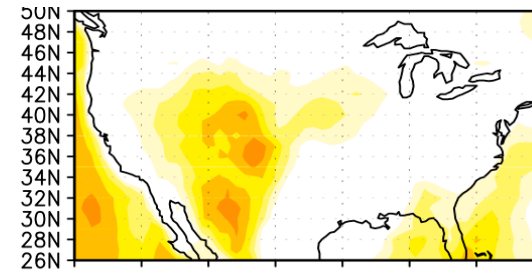
NMME Forecast Skills (AC) for T2m Aug IC for Oct



NMME Forecast Skills (AC) for T2m Aug IC for Nov



GEOS-5 AC for T2m for Oct from Aug IC



GEOS-5 AC for T2m for Nov from Aug IC

